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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
HOGAN, MARY C	
ART UNIT	PAPER NUMBER
2123	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/610,390	WAITE ET AL.	
	Examiner	Art Unit	
	Mary C Hogan	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _7/30/02_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-21_ is/are pending in the application.

4a) Of the above claim(s) _15-18_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-14,19-21_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) _15-18_ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _01 July 2000_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _2,3,4,6_.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

1. This application has been examined.

2. **Claims 1-14, 19-21** have been examined and rejected.

Election/Restrictions

3. Restriction to one of the following inventions is required under 35 U.S. C. 121:

a. Group I: Claims 1-14, 19-21 are directed to the steps of simulating fluid flow in a casting or molding process.

b. Group II: Claims 15-18 are directed to the displaying of visual symbols to show characteristics of the fluid flow.

4. The inventions are distinct from each other because of the following reasons:

5. Inventions I and II are related as combination and subcombination. Inventions in this relationship are distinct if it can be shown that (1) the combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination as claimed does not require the particulars of the subcombination as claimed because Group II deals with using visual symbols to show characteristics of fluid flow while Group I deals with the simulation of fluid flow. The subcombination has separate utility such as indicating the movement of fluid flow in a mold/casting process.

6. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art, restriction for examination purposes as indicated is proper.

7. During a telephone conversation with Mr. James M. Durlacher on 9/24/04 a provisional election was made without traverse to prosecute the invention of **Group I, Claims 1-14 and 19-21**. Affirmation of this election must be made by applicant in replying to this Office action. Claims 15-18 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claim Objections

8. **Claim 12** is objected to because of the following informalities. Appropriate correction is required.

9. **Claim 12** is objected to because it is unclear from the claim language and the specification how the model "corresponds" to a "one dimensional energy equation", what this one dimensional energy

equation is, and to whether or not it relates to a specific energy equation that may be well known in the art.

Claim Interpretation

10. As to **Claim 12**, it was unclear from the claim language and the specification how the model should "correspond" and what the "one dimensional energy equation" refers to. Therefore, this claim was interpreted to mean that the equation contains constants and no derivatives or integrals.

35 USC § 101

11. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

12. **Claims 1-14, 19-21** are rejected under 35 U.S.C. 101 because the claimed invention is not supported by an asserted or well established utility and is not tangible.

13. An invention, which is eligible for patenting under 35 U.S.C.101, is in the useful arts when it is a machine, manufacture, process or composition of matter, which produces a concrete, tangible, and useful result. The fundamental test for patent eligibility is thus to determine whether the claimed invention produces a ***useful, concrete and tangible result.*** The test for practical application as applied by the examiner involves the determination of the following factors:

(1) Useful- The Supreme Court in *Diamond v. Diehr* requires that the examiner look at the claimed invention as a whole and compare any asserted utility with the claimed invention to determine whether the asserted utility is accomplished. Applying utility case law the examiner will note that:

(a) the utility need not be expressly recited in the claims, rather it may be inferred.

(b) if the utility is not asserted in the written description, then it must be well established.

(2) Tangible - Applying *In re Warmerdam*, 33 F.3d 1354, 31 USPQ2d 1754 (Fed. Cir. 1994), the examiner will determine whether there is simply a mathematical construct claimed, such as a disembodied data structure and method of making it. If so, the claim involves no more than a manipulation of an abstract idea and therefore, is nonstatutory under 35 U.S.C. 101. In *Warmerdam* the abstract idea of a data structure became capable of producing a useful result when it was fixed in a tangible medium which enabled its functionality to be realized.

(3) Concrete- Another consideration is whether the invention produces a concrete result. Usually, this question arises when a result cannot be assured. An appropriate rejection under 35 U.S.C. 101 should be accompanied by a lack of enablement rejection, because the invention cannot operate as intended without undue experimentation.

14. Furthermore, although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

15. **Claims 1-14, 19-21** are rejected under 35 U.S.C. 101 because they appear to be reciting a mathematical algorithm, therefore not producing a concrete, tangible and useful result. The claims recite terms such as "forming" and "determining" that describe abstract ideas for solving mathematical equations without the requirement for physical computing equipment. This, the claimed invention further fails to reside in the technological arts and is therefore, non-statutory.

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

18. **Claim 1** is rejected under 35 U.S.C. 103(a) as being unpatentable over Backer et al (US Patent Number 5,377,119), herein referred to as **Backer**, in view of Kubo (US Patent Number 5,677,844), herein

referred to as **Kubo**, further in view of Ebisu et al (U.S. Patent Number 6,530,418), herein referred to as **Ebisu**.

19. As to **Claim 1**, **Backer** teaches: a method for simulating thermal flows for casting/molding processes, comprising:

(a) selecting simulation modules for incorporation in an overall simulation sequence, said modules including a Flow in Shot SLeeve Module **(column 3, lines 9-16** wherein the "runner" is the shot sLeeve and the "mold" that is being modeled in the teaching includes the runner), a Shrinkage Porosity Prediction Module **(column 3, lines 21-23)**; discretizing flow domain into elements having nodes and fluxing surfaces **(Figure 1, element 1)**; inputting initial parameter value and process conditions **(Figure 1, elements 2 and 3)**;

(b) incrementing the time by an incrementing time step **(column 7, lines 8-9, line 18)**;

(c) updating material balance **(Figure 1, element 5)**;

(d) forming and solving momentum equations **(Figure 1, element 5)**, and updating velocity **(column 7, lines 8-37)** and pressure fields **(column 6, lines 28-66)**;

(f) checking if parameters have converged, returning to step (d) if they have not **(Figure 1, element 8 and 9)**;

(g) determining whether an end-simulation event has occurred, returning to step (c) if it has not **(Figure 1, elements 8 and 9)**; and

(h) deciding whether to execute post-processor simulation modules, said post-processor simulation modules including a Mend Line Prediction Module **(column 7, lines 57-63)**.

20. **Backer** does not expressly teach: a Heat Transfer Fluid Line Module, a Die Lubricant Cooling Module, forming and solving energy equations and updating a temperature field.

21. **Kubo** teaches calculating the heat transfer between the mold and the cooling water **(column 4, lines 16-28 and Figure 4, element 43)** and between the mold and the mold cavity **(column 5, lines 36-42)** wherein the temperatures of the mold and mold cavity are calculated by a temperature recovery method. This step of calculating the temperatures of the mold and mold cavity are iterated in the process of the taught invention **(column 7, lines 14-23)** and temperature of the metal is a parameter that may be modified, therefore, it is concluded that a temperature field is updated in this process. Further, **Kubo** teaches that the shrinkage of the metal in the mold is dependent on the temperature of the molten metal **(column 1, lines 35-37)**, and that other parameters, such as the liquid fraction of each element in the mesh, calculated from the heat transfer between the mold and the mold cavity enable the calculation of porosity in the metal.

22. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the calculation of porosity as taught in **Backer** with the calculation of porosity including the calculation of heat transfer (as the heat transfer fluid line module) and the updating of a temperature field as taught by **Kubo** since both **Backer** and **Kubo** are directed to optimizing the casting conditions of metal by minimizing the porosity in the mold since porosity, which results from the shrinkage of the mold in the cavity, causes serious casting defects in the mold as taught by **Kubo (column 1, lines 26-31)**.

23. **Ebisu** teaches forming and solving energy equations **(column 11, item (1) and column 21, lines 22-23)** and including the cooling conditions of a die **(column 24, item (6))** in a method to eliminate defects in a mold, in order to cast steel that is high in quality and has no central segregation and porosity (abstract). The cooling conditions effect the shrinkage of the metal in the mold **(column 3, lines 10-15)**, and the energy equation describes the energy conservation for a certain volume element in the solid-liquid existing zone and is used in the numerical analysis of solidification phenomena on the basis of solidification theory **(column 11, lines 54-57)**.

24. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of optimizing casting conditions as taught in **Backer** to include the cooling conditions (as a die lubricant cooling module) and the calculation of energy equations as taught in **Ebisu** since **Backer** and **Ebisu** are both directed to optimizing casting conditions and eliminating defects such as porosity and the method in **Ebisu** takes into account the cooling conditions which have an effect on the shrinkage of the metal in the die **(column 3, lines 10-15)**.

25. **Claims 2-8** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Backer**, in view of **Kubo**, further in view of White et al (U.S. Patent Number 5,940,309), herein referred to as **White**.

26. As to **Claim 2**, **Backer** teaches: a method, comprising: performing a simulation of a thermal fluid flow in a die for a casting or molding process, the simulation including a model of at least one of: a shot sLeeve and ram for the die **(column 3, lines 9-16** wherein the "runner" is the shot sLeeve and the "mold" that is being modeled in the teaching includes the runner) as a function of ram position, shrinkage of a casting as a function of porosity **(column 3, lines 21-23)**, a heat transfer line embedded in the die, die lubricant cooling, and mend line formation; establishing a finite element mesh for a domain of the thermal fluid flow **(Figure 1, element 1)**; updating a velocity field **(column 7, lines 8-37)**, a pressure field **(column 6, lines 28-66)**, and, said updating including calculating the velocity field as a function of the pressure field; and repeating said updating until a convergence test is satisfied **(Figure 1, element 8 and 9)**.

27. **Backer** does not expressly teach: updating a temperature field relative to the finite element mesh or determining mass flux relative to the finite element mesh.

28. **Kubo** teaches calculating the heat transfer between the mold and the cooling water **(column 4, lines 16-28 and Figure 4, element 43)** and between the mold and the mold cavity **(column 5, lines 36-42)** wherein the temperatures of the mold and mold cavity are calculated by a temperature recovery method. This step of calculating the temperatures of the mold and mold cavity are iterated in the process of the taught invention **(column 7, lines 14-23)** and temperature of the metal is a parameter that may be modified, therefore, it is concluded that a temperature field is updated in this process. Further, **Kubo** teaches that the shrinkage of the metal in the mold is dependent on the temperature of the molten metal **(column 1, lines 35-37)**, and that other parameters, such as the liquid fraction of each element in the mesh, calculated from the heat transfer between the mold and the mold cavity enable the calculation of porosity in the metal.

29. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the calculation of porosity as taught in **Backer** with the calculation of porosity including the calculation of heat transfer and the updating of a temperature field as taught by **Kubo** since both **Backer** and **Kubo** are directed to optimizing the casting conditions of metal by minimizing the porosity in the mold since porosity, which results from the shrinkage of the mold in the cavity, causes serious casting defects in the mold as taught by **Kubo (column 1, lines 26-31)**.

30. **White** teaches a method for simulating mold flow that uses a finite element mesh to describe the flow, computes the flux through the flow domain **(column 3, lines 1-2, 30-33, 38-40)** and further computes the error in these flux calculations in order to determine whether the simulation is converging to a correct solution to eliminate substantial processing time and effort that would be wasted if the wrong process parameters were assumed initially **(column 2, lines 47-51, 66-column 3, line 4)**.

31. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the simulation of fluid flow as taught by **Backer** to include determining the flux (mass, momentum or energy) as taught by **White** since **Backer** and **White** are both directed to simulating fluid flow using a finite element method and the calculation of flux can allow the user of the simulation to use this parameter to determine if the simulation is going to converge to a correct solution as taught by **White (column 2, lines 47-51, 66-column 3, line 4)**.

32. As to **Claim 3**, **Backer** teaches: the method of claim 2, which includes incrementing a simulation time interval and repeating said determination until a stop simulation criterion is met **(column 8, lines 43-51)**.

33. As to **Claim 4**, **Backer** teaches: the method of claim 2, wherein said updating the pressure field and velocity field is based on conserving momentum and mass according to a control-volume based finite element formulation **(column 4, lines 40-62, column 8, lines 44-51**, wherein the pressure and velocity fields are updated as part of the iteration and wherein the momentum and mass are included in the calculations (step 5)).

34. As to **Claim 5**, **Backer** teaches: the method of claim 2, wherein the simulation includes the model of the shot sLeeve and ram for the die, and the model is further provided as a function of one or more dwell parameters **(column 3, lines 14-16** wherein the vacuum degree and velocity of melt flowing in the runner, or shot sLeeve, are the dwell parameters).

35. As to **Claim 6**, **Kubo** teaches: the method of claim 5, wherein said updating includes determining the temperature field according to non-coincident heat transfer between the shot sLeeve, the ram, and the thermal fluid flow **(column 4, lines 16-28 and Figure 4)** wherein the mesh elements of Figure 4 represent elements of the shot sLeeve, ram and fluid flow.

36. As to **Claim 7**, **Kubo** teaches: the method of claim 2, wherein the simulation includes the model of the shrinking of the casting as a function of porosity and further comprising: defining an expression for the porosity as a function of density **(column 5, equation 3 and column 6, lines 52-55)**; identifying nodes with negative pressure **(column 6, lines 11-15 and equation 6)**; creating a reduced pressure gradient field **(column 6, lines 6-8)**; and determining incremental porosity from the reduced pressure gradient field **(column 6, lines 46-55)**.

37. As to **Claim 8**, **Kubo** teaches: the method claim 2, wherein the simulation includes the model of the heat transfer line embedded in the die, and further comprising: representing the heat transfer line with a number of segments each bounded by a corresponding pair of a number of nodes **(Figure 4, element 43 and description)**; determining temperature at each of the nodes **(column 4, equation 2** wherein the term $(T_{i,j,m}-T_{i,j})$ indicates that the temperature at each node has been determined; determining heat transfer between the die and a fluid in the heat transfer line based on the temperature of each of the nodes **(column 4, equation 2)**; and determining the temperature field as a function of the heat transfer **(column 5, lines 35-44)**.

38. **Claim 9 is** rejected under 35 U.S.C. 103(a) as being unpatentable over **Backer** and **Kubo** and **White**, as applied to **Claim 2**, in further view of Lee (U.S. Patent Number 5,050,114), herein referred to as **Lee**.

39. As to **Claim 9**, **Backer** and **Kubo** and **White** teach a method, comprising: performing a simulation of a thermal fluid flow in a die for a casting or molding process, the simulation including a model of at least one of: a shot sLeeve and ram for the die **(Baker: column 3, lines 9-16** wherein the "runner" is the shot sLeeve and the "mold" that is being modeled in the teaching includes the runner) as a function of ram position, shrinkage of a casting as a function of porosity **(Backer: column 3, lines 21-23)**, a heat transfer line embedded in the die, die lubricant cooling, and mend line formation.

40. **Backer** and **Kubo** and **White** do not expressly teach the simulation including a model of the die lubricant cooling, and further comprising: providing one or more thermal properties of a spray lubricant applied to the die with a nozzle; determining a cooling coefficient for the spray lubricant; and computing heat loss from one or more elements of the die by application of the lubricant.

41. **Lee** teaches a method to predict the optimum operating conditions in a two-phase liquid cooling environment using simulation by providing one or more thermal properties of a spray lubricant applied to the die with a nozzle **(column 3, lines 34-41, column 4, lines 6-8)**; determining a cooling coefficient for the spray lubricant **(column 3, lines 50-52)**; and computing heat loss from one or more elements **(column 4, lines 29-45)** wherein the heat flux is the heat loss or heat flow from the elements.

42. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the simulation models as taught by **Backer** and **Kubo** and **White** to include a simulation model for die lubricant cooling using methods as taught in **Lee** since the temperature of the mold is taken into account in the simulation of fluid flow (as taught by **Kubo**) and the temperature of the metal would be effected by the cooling process. Further, since the temperature and heat loss of the metal effects the shrinkage and porosity encountered in the molding process, it would be important to model the cooling of the metal in the mold using methods taught in **Lee** to further improve and optimize casting conditions to eliminate defects such as porosity.

43. **Claims 10-14** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Kubo** in further view of Bharathan et al (U.S. Patent Number 5,661,670), herein referred to as **Bharathan**.

44. As to **Claim 10**, **Kubo** teaches: s method, comprising: providing a model of a heat transfer line in a die for casting or molding **(column 4, lines 20-28)**, the model including a number of segments each associated with one or more element surfaces of the die and a corresponding number of nodes **(Figure 4 and description)**, the model being provided in a one-dimensional form; determining heat transfer between the die and fluid in the heat transfer line with the model as a function of temperature at each of

the nodes **(column 4, lines 20-25)** and simulating a thermal fluid flow in the die based on the heat transfer **(column 1, line 65-column 2, line 9)**.

45. **Kubo** does not expressly teach determining the heat transfer using the Reynolds, Prandtl and Nusselt numbers.

46. **Bharathan** teaches a method that predicts values related to the heat and mass transfer including heat and mass transfer coefficients for a cooling process that uses Reynolds, Prandtl and Nusselt numbers **(Figure 13 and description)**.

47. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the heat transfer determination as taught in **Kubo** with determining the heat transfer using the Reynolds, Prandtl and Nusselt numbers as taught in **Bharathan** since **Kubo** and **Bharathan** are both directed to determining heat transfer in a cooling process.

48. As to **Claim 11, Kubo** teaches: the method of claim 10, which includes linearly interpolating temperature between pairs of the nodes **(column 4, equation 2)** wherein the heat transfer through each element interface is determined, therefore, linearly interpolated.

49. As to **Claim 12, Kubo** teaches: the method of claim 10, wherein the model corresponds to the one-dimensional energy equation (column 4, equation 2).

50. As to **Claim 13, Bharathan** teaches: the method of claim 12, wherein a heat transfer coefficient is determined as a function of the Nusselt, Pandtl and Reynolds numbers **(Figure 13 and description)**.

51. As to **Claim 14, Kubo** teaches: the method of claim 10, wherein said simulating includes updating a temperature field of a finite element mesh representative of a flow domain for the fluid flow **(column 7, lines 14-23)**, wherein his step of calculating the temperatures of the mold and mold cavity are iterated in the process of the taught invention and temperature of the metal is a parameter that may be modified, therefore, it is concluded that a temperature field is updated in this process.

52. **Claims 19-21** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Kubo** in further view of **Lee**.

53. As to **Claims 19-21, Kubo** teaches: performing a simulation of a thermal fluid flow for a casting or molding process **(column 1, line 65-column 2, line 10)** including a model of shrinkage of a casting as a function of porosity **(column 1, lines 49-51, column 2, lines 40-45)** and a model of a heat transfer line embedded in the die **(column 4, lines 16-28 and Figure 4, element 43)**.

54. **Kubo** does not expressly teach: the process including application of a lubricant spray to a die with a nozzle; modeling the application of the lubricant spray in the simulation as a function of a number

of spray parameters, a motion profile of the nozzle, and a cooling coefficient; determining heat loss from the die in response to the application of the lubricant spray with the simulation based on said modeling, wherein the cooling coefficient is determined from a look up table.

55. **Lee** teaches a method to predict the optimum operating conditions in a two-phase liquid cooling environment using simulation including a spray lubricant applied to the die with a nozzle **(column 4, lines 6-8)**; modeling the application of the lubricant spray in the simulation as a function of a number of spray parameters **(column 3, lines 34-41)**, a motion profile of a nozzle **(column 1, lines 35-37)**, a cooling coefficient for the spray lubricant wherein the cooling coefficient is determined from a look up table **(column 3, lines 50-52)**; and computing heat loss from one or more elements **(column 4, lines 29-45)** wherein the heat flux is the heat loss or heat flow from the elements.

56. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the simulation models as taught in **Kubo** to include the effects of applying a lubricant spray with a nozzle as taught in **Lee** since the temperature of the mold is taken into account in the simulation of fluid flow as taught in **Kubo** and the temperature of the metal would be effected by the cooling process when the lubricant is sprayed onto the die. Further, since the temperature and heat loss of the metal effects the shrinkage and porosity encountered in the molding process, it would be important to model the cooling of the metal in the mold using methods taught in **Lee** to further improve and optimize casting conditions to eliminate defects such as porosity.

Conclusion

57. The prior art made of record, see PTO 892, and not relied upon is considered pertinent to applicant's disclosure, careful consideration must be given prior to Applicant's response to this Office Action.

58. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mary C Hogan whose telephone number is 703-305-7838 or 571-272-3712 starting October 25th 2004. The examiner can normally be reached on 7:30AM-5PM Monday-Friday. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin Teska can be reached on 703-305-9704. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see

http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Mary C Hogan
Examiner
Art Unit 2123

KEVIN J. TESKA
SUPERVISORY
PATENT EXAMINER